Unit 7{PRIVATE }
Emergency Response

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{PRIVATE }
EMERGENCY RESPONSE

7.1 INTRODUCTION

This unit is intended to review emergency response operations involving hazardous materials. It is not intended to be a step-by-step guide or a comprehensive training manual. Unit 7 was based on material developed by the New Jersey State Hazardous Materials Training Committee.

7.2 EMERGENCY RESPONSE OPERATIONS

Strategic decisions must be made when dealing with hazardous substance emergencies. The first decision to be made is whether to respond in a defensive or an offensive mode. Offensive operations are those that actively attempt to stop or mitigate the leak. An offensive mode mandates that the proper PPE is available and that personnel have been trained to a proper level of expertise. Defensive operations are those that are focused on stopping the flow of the substance from a safe distance.

No direct contact with the substance should be made. Damming and diking should be attempted far ahead of the substance.

Tactical priorities are those objectives that must be accomplished as soon as possible during the emergency. These priorities include:

- ! isolation of the site;
- ! rescue of people inside the isolation area;
- ! protection from exposures;
- ! fire extinguishment;
- ! confinement of the substance; and
- ! recovery.

It is important to realize that you may not be able to accomplish all of these goals. Without proper PPE you may only be able to accomplish site isolation. Be sure you know your capabilities and do not exceed them.

In certain cases, rescue may not be possible due to excessive risk for the rescue personnel. In all emergencies involving hazardous substances, certain facts should be established prior to attempting rescue:

- probability of victim survival;
- risk to rescuers;
- difficulty of rescue;
- capabilities of rescuers;
- possibilities of explosions and sudden product releases;
- available escape routes and safe havens;
- constraints of time and distance; and
- proper PPE.

The third set of decisions will be analysis of the risks associated with the incident. Risk analysis is an important factor in hazardous materials emergency response. The ability to anticipate the probable course of hazardous materials incidents will allow you to think ahead of the problem and reduce the risk to your response personnel. Certain signs indicate a hazardous materials incident is escalating; these signs should be sought out when analyzing the risk of a hazardous materials emergency:

- vapor trail over a volatile liquid;
- frost forming near a leak;
- deformed containers;
- operation of pressure-relief valves;
- pinging of heat-exposed vessels;
- extraordinary fire conditions;
- peeling of container finish;
- boiling of unheated materials;
- colored vapor clouds;
- smoking or self-igniting materials;
- peculiar smells;
- deterioration of equipment; and
- unexplained changes of any type.

Any of the preceding conditions may indicate a rapid degeneration in scene conditions, and if any of these are noted, scene evacuation should be considered a priority.

The risk level of the incident can be further assessed through proper substance identification.

To handle hazardous substances safely, you must be able to obtain pertinent information about the substance. Many resources exist to give you information on the substance. Before any of these sources may be used, you must first identify the substance. The following are possible clues to assist you in identification.

ContainersCThe type of container can help you determine the type of substance that it holds (liquid, solid, or gas).

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Placards and LabelsCPlacards are diamond-shaped signs, affixed to transport vehicles. They can give you information about the cargo by indicating the DOT hazard class for the product (explosive, compressed gas, flammable liquid, and so forth). A four-digit number may be located on or next to the placard. This is known as the United Nations/North American (UN/NA) number. This number may identify the product when referenced to the DOT Response Guidebook.

Labels are located on the packages; they also indicate the hazard class/classes for the substance.

NFPA 704CThis is a diamond-shaped sign affixed to buildings or stationary tanks. While it doesn't precisely identify the product, it will give you information about its hazardous properties.

ManifestsCManifests or shipping papers, if they are included with the substance, may be the best source of identification. They usually list the product by name and UN/NA number. With certain incidents, you may not find manifests, or you may not be able to recover them.

Existing Records or DocumentationCWhen dealing with waste cleanup operations, any records detailing what may have been produced or used on-site may assist in identification.

Visual ObservationsCOne of the first clues that should be used in identification is visual observation from a safe distance. This should become an ongoing procedure. Information about the container, chemical properties/reactions, placards, and labels may be obtained by visual observation.

Technical ReportsCReports detailing what chemicals were used in a certain operation may yield clues to possible unknown substances.

Direct Reading Field InstrumentsCField instruments can determine the concentration of a substance in the air. Others can determine flammable vapor mixtures or oxygen concentration. Finally, some can be used to identify the product.

Lab AnalysisCThe most accurate way to identify the substance is to obtain samples and send them for lab analysis. This will positively identify the substance, but it requires time for the analysis to be completed.

ResourcesCAfter the substance has been identified, you can consult resources available in written, computer, and verbal forms. Some of these sources follow:

! **Chemical Hazard Response Information System** (CHRIS)
! **Chemistry of Hazardous Materials**
! **The Condensed Chemical Dictionary**
! **CRC Handbook of Chemistry and Physics**
! **Dangerous Properties of Industrial Materials**
! **Department of Transportation Emergency Response Guidebook**
! **The Merck Index**
! **NIOSH/OSHA Pocket Guide to Chemical Hazards**
! **Emergency Care for Hazardous Materials Exposure**
! **Material Safety Data Sheets**
! **Computer Programs**

Many computer programs are available to supply information about chemical substances. Some can be purchased and others can be accessed through modems or by phone. Some of the most popular data systems are listed below.

! **OHMTADS**CChemical Information System, Inc., (301) 321-8440.
! **CHRIS**CChemical Hazard Response Information System, (301) 321-8440.
! **CAMEO**CComputer-Aided Management of Emergency Operations, (206) 526-6317.
! **TOXLINE**CToxicological Information On-Line, (301) 496-6193.

VERBAL RESOURCES

! **CHEMTREC**CChemical Transportation Emergency Center, (202) 483-7616 1-800-424-9300.
! **ATSDR**CAgency of Toxic Substances and Disease Registry.
(404) 639-0616 24-Hour Emergency Response.
(404) 639-6000 Toxicological Profiles

7.3 D.E.C.I.D.E.

The D.E.C.I.D.E. process allows the incident commander to safely intervene in an emergency.

To guide intervention during an emergency, certain basic decisions must be made. Decision-making calls for emergency response personnel to:

- **D**etect hazardous materials presence;
- **E**stimate likely harm without intervention;
- **C**hoose response objectives;
- **I**dentify action options;
- **D**o best option; and
- **E**valuate progress.

7.3.1 DETECT HAZARDOUS MATERIAL PRESENCE

If you are not aware that a hazardous material problem exists, how can you protect against a nasty surprise?

7.3.2 ESTIMATE LIKELY HARM WITHOUT INTERVENTION

This is a difficult but indispensable step. If you don't know what is going to happen, how can you define your problem and how to deal with that problem? How can you choose your objectives?

7.3.3 CHOOSE RESPONSE OBJECTIVES

You have to identify the potential harm you want to prevent (the exposures you want to guard against) before you can act in a rational manner.

7.3.4 IDENTIFY ACTION OPTIONS

With your objectives, what options do you have to accomplish those objectives? You must consider your practical options before you act.

7.3.5 DO BEST OPTION

When you have multiple options, you should pick the option that provides a solution to your problem, one with the greatest gain and the least loss.

7.3.6 EVALUATE PROGRESS

After you decide what to do, you have to make sure that what you expected to happen is actually happening. If not, you must review the problem and select another option to lead to the desired results.

7.4 DECISION-MAKING IN EMERGENCIES

7.4.1 EVENTS ANALYSIS

Estimating likely harm without intervention is an important step in the

DECIDE process. This concept includes two basic activities:

- predicting what is likely to happen in an emergency; and
- describing the likely outcome based on that assessment.

The first step in estimating likely harm without intervention is events analysis. Events analysis is defined as the process of breaking down complex actions into smaller, more easily understandable parts. The process of events analysis provides a means to track and predict the sequence of past and current events to determine the time and type of actions necessary to change that sequence.

The first step is estimating the likely harm without intervention.

Events analysis helps to define problems in a sequential and logical way, thus minimizing confusion, guesswork, mistakes, delays, unnecessary harm, and loss of control at emergencies. The steps in events analysis are:

- identify all components of an emergency;
- identify the effects of each component; and
- identify all possible outcomes.

7.4.2 METHODOLOGY FOR PREDICTING OUTCOME

As emergency events are visualized, the type of harm that is likely to occur as a result of the behavior present should also be estimated. This mental picture of the likely injury and damage is the objective of the estimate likely harm without intervention step in the DECIDE process. Estimates should indicate the outcome in terms of:

- fatalities;
- injuries;
- property damage;
- critical system disruption; and
- environmental damage.

A risk analysis plan will help you anticipate the course of the hazardous substance emergency.

Outcome estimates begin on arrival, and may be modified as additional information becomes available. You cannot prevent that which has already occurred before you arrived. In the past, emergency response personnel have responded to many emergencies with little help in making decisions, especially in making the estimates discussed in this unit. They improvised to the best of their ability, and frequently succeeded in quelling the problem before it compounded the harm, often through sheer determination and reasonable luck. The main thrust of this course is to show you how you can improve the degree of certainty in making these estimates. You should recognize that the greater the uncertainty, the greater the need for expert assistance to help you make the estimates discussed. Personnel should have their assigned responsibilities.

Part of the role of the Emergency Program Manager is to collate and analyze outcome estimates, to coordinate community preparations for "worst case" scenarios, and to coordinate information flow from the on-scene commander to appropriate policy and operational elements within the community.

7.5 HAZARDOUS MATERIALS BEHAVIOR

Four factors affect the behavior of hazardous materials in an emergency. They are:

- inherent properties and quantity of the hazardous material;
- built-in characteristics of the container;
- natural laws of physics and chemistry; and
- environment, including the physical surroundings (terrain) and the conditions (weather).

Determining the interrelationship among these factors can help considerably in visualizing what is likely to happen in the emergency. To look at this interrelationship, consider how a hazardous material behaves in an emergency. Remember the definition of a hazardous material is any substance that ejects out of its container when something goes wrong, and hurts or harms the things it touches or impinges upon.

Experience has shown that hazardous materials behavior in an emergency follows a basic sequence of events. Under normal conditions, hazardous materials are controlled by some kind of container (tanks, pipes, cylinders, bottles, bags, etc.). For an emergency to begin, the container must be disturbed or stressed in some way. This is known as the STRESS event. If the container is stressed beyond its recoverable limits (design strength or ability to hold the contents), the container opens up. This is known as the BREACH event. When the container breaches, the contents can escape. Contents escape in the form of matter or energy or a combination of both. This is known as the RELEASE event.

Escaping matter and/or energy travels away from the point of release, forming predictable patterns governed by natural laws of physics and chemistry. This is known as the ENGULF event. As the hazardous material and/or container travels away from the release point, it (they) may touch or impinge upon vulnerable exposures such as people, systems (including the environment), and property. This is known as the IMPINGE event. The impinged exposures may be harmful, depending on the dosage or concentration of the material impingement. This is known as the HARM event.

Each event, in sequence, characterizes hazardous materials emergencies. The Hazardous Materials General Behavior Model considers each event in visualizing what is likely to happen in a hazardous materials emergency.

Certain questions should be answered in visualizing what is likely to happen in an emergency.

- Where is the hazardous material/container likely to go when released in an emergency?
- Why is the hazardous material/container likely to go there?
- How will the hazardous material/container get there?
- When will the hazardous material/container get there?
- What harm will the hazardous material/container do when it gets there?

The Hazardous Materials General Behavior Model incorporates basic concepts in events format. The model defines the sequence of events which characterize a hazardous materials emergency.

The events are:

- stress;
- breach;
- release;
- engulf;
- impinge; and
- harm.

7.6 INCIDENT MANAGEMENT

The successful mitigation of a hazardous materials emergency depends on actions preformed by the first responders. Safety must be the primary concern when responding to hazardous materials emergencies. First responders must not commit themselves without the proper training and equipment. Additional resources for dealing with hazardous materials incidents should be notified as soon as possible. Many incidents involve multiple agency response. A plan or system must be established to effectively manage this response.

7.6.1 INCIDENT COMMAND SYSTEM (ICS)

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The Incident Command System (ICS) consists of procedures to control personnel, facilities, equipment, and communications.

Although many systems exist throughout the nation for the command and control of resources at emergency incidents, the National Fire Academy has adopted the Incident Command System (ICS) as its base for teaching the concepts of incident command. The ICS is recognized by the Academy as a system that is documented and has been successfully used in managing available resources at emergency operations.

It is designed to begin developing from the time an incident occurs until the requirement for management and operations no longer exists. The "Incident Commander" is a title that can apply equally to an engine company captain, the chief of a police department, or an emergency coordinator of a fixed facility depending upon the situation. The structure of the ICS can be established and expanded depending upon the changing conditions of the incident. It is intended to be staffed and operated by qualified personnel from any emergency services agency and may involve personnel from a variety of agencies.

As such, the system can be utilized for any type or size of emergency, ranging from a minor incident involving a single unit, to a major emergency involving several agencies. The ICS allows agencies to communicate using common terminology and operating procedures. It also allows for the timely combining of resources during an emergency.

The ICS is designed to be used in response to emergencies caused by fires, floods, earthquakes, hurricanes, riots, hazardous materials, and other natural or human-caused incidents.

7.6.1.1 Primary Features Of The Incident Command System

AdaptabilityCan all-hazards incident management system that readily adapts itself to your incident.

FlexibilityCeasily expands as the incident expands just by adding additional ICS elements.

Span of Control Cno more than five subordinates for one supervisor.

Unity of Command Ca chain of command that is established:

! everyone knows who is in charge; and
! everyone knows who to report to.

7.6.1.2 Organization and Operation

The ICS has five major functional areas:

- command (Emergency Response Coordinator);
- operations (Emergency Response Coordinator);
- planning (Manager of Environmental Affairs);
- logistics (District Manager); and
- finance (District Manager).

7.6.2 SECURE THE SCENE

The first responsibility at hazardous materials incidents is to secure the scene. The scene must be isolated so no further injuries will occur. This will involve denying entry to the site. Only necessary response personnel should be allowed at the scene.

7.6.3 RESPONSE ZONES

Response zones should be established. These zones will assist in isolating the scene and protecting public and response personnel.

The "Hot Zone" is the area immediately surrounding a hazardous materials incident. It extends far enough to prevent adverse effects from hazardous materials releases to personnel outside the zone. This zone is also called the exclusion or restricted zone.

The "Warm Zone" is the area where personnel and equipment decontamination takes place. It includes controlled access and exit points. All personnel entering the hot zone must go through decontamination in the warm zone. This zone is also called the decontamination, or contamination-reduction zone.

The "Cold Zone" is the area that contains the command post and such other support functions as are deemed necessary to control the incident. This zone is also called the clean or support zone.

A number of factors determine where the response zone boundaries will be located. This starts with a visual survey of the immediate scene, a risk assessment of the substances involved, and the use of monitoring equipment. The potential of fire and explosions must also be considered. First responders should establish the boundaries using the information provided in the Emergency Response Guidebook. Many reference texts suggest that a hot zone of 2000 feet should be established with unknown products or extremely dangerous substances. When responders with higher levels of training and monitoring equipment arrive, the zone boundaries can be modified as necessary.

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7.6.4 INCIDENT LEVELS

Hazardous materials incidents can be divided into three different response levels.

The level of the incident can be classified as Level I, II, or III. Level I incidents are those within the capabilities of the local jurisdiction (if they have been trained to at least the operations level). Level II incidents require the assistance of two or more agencies. Level III incidents are those requiring the assistance of state and federal agencies for efficient mitigation.

7.7 CONFINEMENT AND CONTAINMENT

7.7.1 INTRODUCTION

No two spill-related emergencies are the same. Spills can occur at fixed facilities, either during the processing of the material or during the loading/offloading of the material. Spills also occur in the field setting, during the transportation of hazardous materials.

NFPA document 471, Recommended Practice for Responding to Hazardous Materials Incidents, defines confinement as those procedures taken to keep a material in a defined or local area, and containment as those procedures taken to keep a material in its container.

To assess the best method for confinement and containment, you must understand the material that has spilled. A minimum assessment of the material should include:

- identification of the spilled material involved;
- the physical properties of the spilled material;
- the current and forecasted weather; and
- the local topography.

This will allow you to answer the following questions.

1. What is the nature of the materials involved?

2. Where will the materials go now that they have been released?

3. What can be done to reduce the hazards associated with the spilled materials?

During emergency releases in the field setting, environmental damage can occur before confinement or containment procedures can begin. As you begin to develop a plan, keep in mind the following questions.

1. The volume of hazardous materials released to the environment and the rate of leak, if still in progress.

2. What dangers exist to personnel involved in the area?

3. The nature of the damage to the vessel and what repairs might be attempted.

4. It is possible to transfer the material to an alternate container?

5. Should some form of dike be constructed around the spill area?

6. The exact nature of the spill area and how the material has spread over the area.

7. Whether the material has or can reach a waterway or sewer?

8. Is there a danger of fire or explosion?

9. What effect will rain and wind have on the spilled material?

10. What equipment and supplies will be necessary to confine the substance?

{PRIVATE **}7.7.2 HAZARDOUS RELEASES{**tc \l 2 "**7.7.2 HAZARDOUS RELEASES"}**

The four basic types of releases are:

! air releases;
! land spills;
! water discharges; and
! ground water contamination.

7.7.2.1 <u>Air Releases</u>

If the material released has a vapor density < l (lighter than air), the only effective containment is to plug the leak and/or evacuate the area. This depends on the size of the vapor cloud created. Restriction of the air space over the incident should also be considered.

If the material released has a specific vapor density > 1 (heavier than air), this material tends to hug the ground at the level of release or

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lower. In this case, the only effective containment is to evacuate the area downwind and recognize that the flow of the material may find an ignition source which would produce a flashback fire leading directly back to the source of the leak. With some materials, the use of fog patterns to disperse the vapor cloud has worked.

7.7.2.2 Land Spills

This includes the escaping of a material from a container and leaking onto the ground. Also included would be contamination from by-products or combustion. An example would be a fire at a chemical warehouse where the temperature did not reach above 1800^{o} F, hot enough to destroy the chemicals stored in the warehouse. The easiest method for confinement of a land spill is an earthen dike. The basic dike is constructed with dirt. The materials and manpower to construct this type of dike are usually available and inexpensive.

However, over time, both vertical and horizontal seepage through and around the dike will occur. This process can be slowed by the use of "visqueen" or "poly" plastic sheets, (a form of polyethylene). The polyethylene is used as a base in the construction of a dike or a drainage ditch.

A good alternative is to transfer the product remaining in the vessel to another container. It still may be necessary to dike around the original spill, while you wait for the second container to arrive.

7.7.2.3 Water Discharges

This form of contamination has been researched longest and because of that, there are more ways to contain spills in, on, and under the water (if the spilled material has a specific gravity > 1 and is insoluble or slightly soluble in water). The best method for confinement is an overflow dam. Additional staging of material and manpower downstream will need to occur. This is in case the first dam breaks and allows the release of the contaminates downstream. This system works best on slow-moving waterways. Also, you could evacuate a depression in the waterway and allow the spilled material to collect there. However, the faster the waterway, the less likely that this method will work.

If the spilled material has a specific gravity < 1, and is insoluble or slightly soluble in water, the best method of confinement is a floating boom. There are several different types of booms on the market. Also, there are sorbent booms on the market. Instead of confining the spill, these booms adsorb the spill. Neither product works well in rough water or fast currents. Another option is the use of an underflow dam or siphon dam. An underflow dam is a dike constructed with a pipe placed in the dike. The pipe is placed lower on the upstream side and higher on the downstream side. This allows for the following of the waterway through the piping and traps the contaminants on the upstream side. As with the overflow dam, it will be necessary to have additional manpower and supplies downstream in case of a break in the dam. Chicken-wire fencing and hay can be used to create a fixed barrier. This method is generally limited to smaller waterways and creates special problems in disposal.

If the material spill has a specific gravity of 1 and is soluble or insoluble in water, there is very little that the first responder can do. If the waterway is small, you can dam the waterway and recover or filter the water. The other option is to neutralize the chemical, rendering the chemical inert. This will require the resources of the EPA and local health departments for technical assistance before it is attempted.

7.7.2.4. <u>Ground Water Contamination</u>

Ground water contamination is not normally handled by first responders. The best thing that can be done is to make sure that no other hazards exist. Ground water contamination plumes move slowly and allow for more technical resources to be used to handle the problem.

Remember that almost all chemicals are subject to change: water can change from ice to water and from water to water vapors. Based on the information, you will need to assess the hazards associated, then establish an appropriate confinement plan.

7.7.3 FOAM OPERATIONS

Firefighting foams can be used at the hazardous materials incident to extinguish fires or to suppress vapors. Many types of foams are available and the correct foam must be used for maximum efficiency.

Foam works to extinguish flammable and combustible liquid fires by:

- suppressing vapor production;
- excluding air from the fuel;
- separating the flame from the fuel; and
- cooling the fuel and exposed surfaces.

AFFF and ATC foams are the most widely used in emergency response operations. AFFF will give the fastest extinguishment for hydrocarbon fires but is not recommended for use on polar solvents. Special Hazmat foams are available to suppress the vapors from acid and alkali spills.

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AFFF and ATC foams work by forming a smothering blanket across the top of the fuel. AFFF will break down when used on water-miscible liquids or polar solvents. In these cases, an alcohol resistant (ATC) foam should be used. ATC foams form a polymeric barrier on the top of the fuel. AFFF and alcohol resistant foams may not be compatible with each other. Foams are ineffective on vertical surfaces due to the lack of "sticking" properties. Foams should be applied in front of the fuel and gently spread across the surface of the fuel. If the foam is sprayed directly into the fuel, the blanket may be disrupted and the fire may reignite. If the foam must be sprayed into a tank, it should be directed onto a vertical surface and allowed to flow down into the tank.

7.8 DECONTAMINATION PROCEDURES

7.8.1 INTRODUCTION

Increasingly, emergency response personnel are being called upon to respond to and control hazardous materials incidents. Recently, more consideration has been given to the potential short- and long-term effects of contact with hazardous substances. The impact of some highly toxic chemicals can be immediate and acute. In other instances the effects can be measured only in the long term. In still other cases, it is yet unknown what the short- and long-term effects are.

Recognizing this problem, chemical-protective clothing has been developed to allow emergency response personnel to work directly with the hazardous material when such action is necessary to stabilize a particular incident. Yet, even at incidents where proper protective clothing has been utilized, contamination has been needlessly spread outside the immediate area of the emergency. Substances have adhered to protective clothing and been tracked about. Run-off from washdowns have been allowed to enter water supplies. Ambulances and medical facilities have, on occasion, been unnecessarily endangered by contaminated patients. It is clear that fire departments, police, emergency medical and rescue units, emergency management agencies, hazardous substance clean-up crews, government personnel, and any others who respond to hazardous materials incidents must be concerned with the control of contamination, on and off the emergency site. The management and termination of a hazardous materials incident must include steps taken to be sure contamination is reduced and properly disposed of.

Decontamination must be part of the pre-incident planning and included in an SOP.

Decontamination is the process by which personnel, apparatus, equipment, and supplies are made safe by the reduction of hazardous substances. In many instances, a decontamination procedure can be as simple as a washdown with water from a booster line. At other times the procedure must be more complex and time consuming. Emergency response units must prepare for and carry out decontamination for many kinds of hazardous substances. This is a particularly difficult and dangerous task if the material in question is unknown. Procedures must be developed and written down as part of the emergency response pre-incident planning. Personnel must be trained to carry out these procedures, and records should always be kept.

7.8.2 EXTENT OF DECONTAMINATION REQUIRED

The original decontamination plan must be adapted to specific conditions found at each incident. These conditions may require more or less personnel decontamination than planned, depending on a number of factors.

7.8.2.1 Type of Contaminant

The extent of personnel decontamination depends on the effects the contaminants have on the body. Contaminants do not exhibit the same degree of toxicity (or other hazard). Whenever it is known or suspected that personnel can become contaminated with highly toxic or skin-destructive substances, full decontamination procedures should be followed. If less hazardous materials are involved, the procedure can be downgraded.

7.8.2.2 Amount of Contamination

The amount of contamination on protective clothing is usually determined visually. If it is badly contaminated, a thorough decontamination is generally required. Gross material remaining may degrade or permeate it. This likelihood increases with higher air concentrations and greater amounts of liquid contamination. Gross contamination also increases the probability of personnel contact. Swipe tests may help determine the type and quantity of surface contaminants.

7.8.2.3 Level of Protection

The level of protection and specific pieces of clothing worn determine, on a preliminary basis, the layout of the decontamination line. Each level of protection incorporates different problems in decontamination and doffing of the equipment. For example, decontamination of the harness straps and backpack assembly of the self-contained breathing apparatus is difficult. A butyl rubber apron worn over the harness makes decontamination easier. Clothing variations and different levels of protection may require adding or deleting stations in the original

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decontamination procedure.

7.8.2.4 Work Function

The work each person does determines the potential for contact with hazardous materials. In turn, this dictates the layout of the decontamination line. For example, observers, photographers, operators of air samplers, or others in the exclusion zone performing tasks that will not bring them in contact with contaminants may not need to have their garments washed and rinsed. Others in the exclusion zone with a potential for direct contact with the hazardous material will require more thorough decontamination. Different decontamination lines could be set up for different job functions, or certain stations in a line could be omitted for personnel performing certain tasks.

7.8.2.5 Location of Contamination

Contaminants can be located either on the surface of PPE or permeated into the PPE material.

Contamination on the upper areas of protective clothing represent a greater risk to the worker because volatile compounds may generate a hazardous breathing concentration both for the worker and for the decontamination personnel. There is also an increased probability of contact with skin when doffing the upper part of clothing.

7.8.2.6 Reason For Leaving Site

The reason for leaving the exclusion zone also determines the need and extent of decontamination. A worker leaving the exclusion zone to pick up or drop off tools or instruments and immediately returning may not require decontamination. A worker leaving to get a new air cylinder or to change a respirator or canister, however, may require some degree of decontamination. Individuals departing the CRC for a break, lunch, or at the end of the day, must be thoroughly decontaminated.

7.8.2.7 Effectiveness of Decontamination

All personnel, clothing, equipment, and samples leaving the contaminated area must be decontaminated.

There is no method to immediately determine how effective decontamination is in removing contaminants. Discolorations, stains, corrosive effects, and substances adhering to objects may indicate contaminants have not been removed. However, observable effects only indicate surface contamination and not permeation (absorption) into clothing. Also, many contaminants are not easily observed.

A method of determining effectiveness of surface decontamination is swipe testing. Cloth or paper patchesCswipesCare wiped over predetermined surfaces of the suspect object and analyzed in a laboratory. Both the inner and outer surfaces of protective clothing should be swipe tested. Positive indications of both sets of swipes would indicate surface contamination has not been removed and substances have penetrated or permeated through the garment. Swipe tests can also be done on skin or inside clothing. Permeation of protective garments requires laboratory analysis of a piece of the material. Both swipe and permeation testing provide after-the-fact information. Along with visual observations, results of these tests can help evaluate the effectiveness of decontamination.

7.8.2.8 Equipment

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations are ease of equipment decontamination or disposability. Most equipment and supplies can be easily procured. For example, soft-bristle scrub brushes or long-handle brushes are used to remove contaminants. Water in buckets or garden sprayers is used for rinsing. Large galvanized wash tubs or stock tanks can hold wash and rinse solutions. Children's wading pools can also be used. Large plastic garbage cans or other similar containers lined with plastic bags can store contaminated clothing and equipment. Contaminated liquids can be stored temporarily in metal or plastic cans or drums. Other gear includes paper or cloth towels for drying protective clothing and equipment.

7.8.2.9 Decontamination Solution

Decontamination procedures, under certain circumstances, may pose health and safety hazards.

PPE, sampling tools, and other equipment are usually decontaminated by scrubbing with detergent-water using a soft-bristle brush followed by rinsing with copious amounts of water. While this process may not be fully effective in removing some contaminants (or in a few cases, contaminants may react with water), it is a relatively safe option compared with using a chemical decontaminating solution. This requires that the contaminant be identified. A decon chemical is then needed that will change the contaminant into a less harmful substance. Especially troublesome are unknown substances or mixtures from a variety of known or unknown substances. The appropriate decontamination solution must be selected in consultation with an experienced chemist.

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7.8.3 ESTABLISHMENT OF DECONTAMINATION PROCEDURES

Once decontamination procedures have been established, all personnel requiring decontamination must be given precise instructions (and practice, if necessary). Compliance must be frequently checked. The time it takes for decontamination must be ascertained. Personnel wearing SCBAs must leave their work area with sufficient air to walk to CRC and go through decontamination.

Personnel who perform decon procedures must also wear proper PPE, the same level of protection or one step lower than the workers they are decontaminating.

7.8.4 {PRIVATE }DECONTAMINATION METHODS{tc \l 2 "DECONTAMINATION METHODS"}

DilutionCrinsing substance with water. Will dilute the substance but not change the hazards. Contaminated runoff is a problem.

Chemical Neutralization or Degradation Cdegradation includes washing with soap or other decon solution. Process may reduce the chemical hazard but may cause an exothermic reaction, toxic gas production, and suit degradation.

AbsorptionCprocess is used for equipment, tools, and flat surfaces. Absorbent must be picked up and the absorption process does not change the chemical hazard.

Isolation and Disposal Cat times, equipment may not be able to be safely and completely decontaminated. Articles should be isolated and treated as hazardous waste.

There are two basic levels of decontaminationCGross decon, the removal of a major portion of contaminants, and definitive decon, the thorough removal of all contaminants.

At some incidentsCa minor chlorine leak at the local swimming pool, for instanceCgross decon is sufficient. Providing that there are provisions to catch run-off, a simple rinsing of protective clothing at the scene and a shower back at the station is all that is necessary to accomplish gross decon.

Exposure to some hazardous materials, such as poisons, warrants definitive decon system implementation. These are substances that can incur serious short-term health effects if complete decontamination is not carried out quickly and efficiently. The definitive decon system, therefore, merits serious attention.

Setting up a definitive decon system may seem beyond the resources of some departments, as with other areas of preparation for Hazmat incidents: equipment, training, manpower, etc. Expenditures are sometimes hard to justify for something that's seldom (if at all) needed. However, to protect personnel properly, it is imperative to be prepared to provide definitive decontamination. An in-house decon system can be designed and implemented with minimal funding and a lot of planning.

Definitive decon systems for warm weather use can be designed inexpensively, and many excellent articles have been written suggesting ways of definitive on-scene decon. Of course, out-of-doors definitive decon is not very practical in cold weather. Imagine stripping down and showering in a portable on-scene shower, with only a sheet of plastic or salvage cover draped over the shower frame to protect you from sub-zero wind chills!

The alternative to out-of-doors definitive decon in cold weather is an in-house system. The main priority of an in-house definitive decon system is to decontaminate personnel in a quick, thorough, and efficient manner. Decon of equipment, clothing, and apparatus can be accomplished later in a less urgent manner in cooperation with the EPA, water treatment officials, and other knowledgeable people who can help monitor and decon these items.

An in-house decon system moves contaminated personnel from the incident scene to another location, usually a fire station. There is still a need for on-scene decon, consisting of a quick gross decon and removal of outer protective clothing, such as a chemical suit. The personnel are then transported to the definitive decon location, while keeping breathing apparatus in place. A station wagon or other utility vehicle can be used for transportation. In serious contamination incidents, the driver of the transport vehicle may also be required to wear breathing apparatus and may also have to go through decon. The vehicle will have to be checked for contaminants and decontaminated if necessary before being put back in service.

7.9 IMPLEMENTING A SAFETY PLAN

7.9.1 COMPONENTS OF A SAFETY PLAN

Besides being the common-sense way to effectively and safely handle

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Hazmat incidents, planning is also a legal requirement. OSHA, RCRA, and SARA all require planning by either the private employer and/or public agencies. By law, state, county, and local governments are required to have basic emergency management plans that will cover many possible disasters. As an annex to the disaster planning process, SARA requires the development of a plan that specifically addresses hazardous materials. This hazardous materials contingency plan should be the basis for the response of all expected emergency responders to a Hazmat incident.

A hazardous materials plan should contain the following information:

- identity of hazards within the jurisdiction;
- assumption of what would happen if an incident occurred at one of the hazardous materials locations;
- a policy statement that identifies the expected operations and defines roles and authority, as well as notification of other agencies;
- phases of emergency management including mitigation, preparedness, response, and recovery;
- direction and control, including alerting of the public, emergency operations center (EOC) activation, and cleanup on site;
- organization and assignment with responsibilities assigned to specific department heads;
- administration and logistics for support of the operations envisioned in the contingency plan; and
- appendices that provide for mutual aid, emergency response reference guides, telephone numbers of people, industries, and agencies that might be called upon for assistance. These appendices should also include contractor response procedures (to obtain a bulldozer), evacuation and traffic routing information, and any other needed information that supports the Hazmat plan.

These plans should have been developed by a planning committee that included representation from many different agencies, as well as the public, and are as site-specific as possible to take into account local conditions. The process of preparing for a Hazmat incident does not end with the development of the plan. For any plan to work, it must be known to the people expected to use it and they must have practiced with it. Even the best appearing plan will not be effective if the responders have not tried it out to see if it is realistic. As part of the process of being an emergency responder, you must know the local plan, your role in it, and what is expected of you.

In addition to preparing hazardous materials contingency plans, one will need to develop other types of plans to operate efficiently and safely.

Earlier, mutual aid plans and response plans were mentioned. It is also necessary to consider the need for action guides/checklists and standard operating procedures (SOPs).

Action guides/checklists break procedures down into simple parts and provide a method of ensuring that all of the parts have been accomplished, including proper sequence. They are designed to be a reminder for a trained, qualified person and while they may serve as guides to assist in training, they do not replace the need for training.

Standard operating procedures are written directions for a specific situation. They may describe how to operate a particular piece of equipment, how to don a particular piece of personal protective equipment, or what is an appropriate method of decontamination. These should be developed in a step-by-step manner and with each step described as fully as possible, as well as in the proper sequence. After learning an SOP, an action guide or checklist will help one complete all of the steps correctly.

Both action guide/checklists and SOPs help provide the discipline needed to minimize the risks associated with a Hazmat response. In addition to protecting personnel, they will provide a basis to conduct a critique of both incidents and drills. SOPs and checklists can also provide valuable documentation of an incident.

7.9.2 SAFETY AND HEALTH OFFICER

OSHA 1910.120 defines a site Safety Officer as "the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with the applicable safety and health requirements."

While OSHA's definition may more directly define a Safety Officer at a hazardous waste site (Superfund site), it does not lessen the need for a safety officer for a Hazmat emergency response. Any SOPs or plans that are developed for response to emergencies (including Hazmat) should provide for a Safety Officer. The role of the safety officer must be defined as well as the responsibility and authority of that officer. Whoever that person might be, they must have the authority to stop unsafe acts and they should report directly to the incident commander.

7.9.3 PRE-INCIDENT

Incident recordkeeping begins long before the actual incident. Records are kept on both the individuals and equipment which will respond to an incident. This includes your department's training records for all courses and drills attended by members.

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Medical records should be maintained. In addition to the medical surveillance reports that are required for hazardous materials team members, respirator fit-test records for persons who will be using respirators should also be maintained.

Records should also be kept for equipment to show maintenance and inspection of each piece. Monitoring equipment must be calibrated on a routine basis, which also should be recorded.

7.9.4 ALARM

Upon receipt of an alarm that a hazardous material incident has occurred, the type of response that your department makes will be based on the information you are able to obtain.

Upon notification of a hazardous material incident, an incident report form should be fully completed. This form should be structured to allow screening the extent of hazard or risk of the incident. All names should be confirmed with the caller and should be checked for correct spelling. As the type of further action initiated will be based on this information, the incident report form must be as accurate as possible.

Notification of other government departments and agencies will be made on a case-by-case basis.

7.9.5 ON-SITE

Upon arriving on-site, records must be kept for safe operations. An incident control chart can be used to verify the information received on the incident report. Since many chemicals have similar sounding names or may involve many letters and numbers (some have over 60 characters in their name), make sure you write it down and check for accuracy.

Throughout the incident a chronological log should be maintained at the command post. This may be the most important document as the decisions made, actions taken, and who performed them, are vital pieces of information needed in post-incident analysis.

While operations are taking place, an access control log should be maintained for information about the specific individual who may be on-site at any given time. Should an on-site emergency take place, the Safety Officer must know who was on-site and what they were doing. This log should also show the time an individual went on SCBA air, the estimated duration, and anticipated exit time. The type of exposure to each individual along with decontamination methods used are part of the reporting process. Finally, a record must be kept on-site of all resources used, who supplied them, when, and what. Upon completion of the incident, reimbursement and payment may take place for the resources used. Your log will be important in settling these claims.

7.9.6 TERMINATION PROCEDURES

Termination of an incident can only be conducted when the hazard has been contained. The threat to public health, safety, welfare, and the environment must be evaluated and controlled prior to closing out the incident. In many situations, termination of the emergency may require turning the site over to the health department or other authority having jurisdiction to supervise a final cleanup and removal operation. These operations may run from hours to months in length, depending on the extent of environmental damage.

7.9.7 POST-INCIDENT

There is currently no single incident reporting system recognized for hazardous materials incidents. The most commonly used system presently is the National Fire Incident Reporting System (NFIRS) in the fire service. Some hazardous materials units have developed their own incident reporting system. Whichever system is used by your department, make sure it covers the following pertinent items:

- what happened, when, where;
- who responded, both departments and specific individuals;
- which individuals went on site;
- why this incident happened;
- exposure and decon records; and
- chronological log of the incident operations.